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In re Application: Seong Soo JANG

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For: METHOD FOR IMPROVING RELIABILITY OF REACTION APPARATUS

Commissioner for Patents  
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I, Jong-Gueol PARK, a citizen of the Republic of Korea and a staff member of YUIL International Patent and Law Firm do hereby solemnly and sincerely declare:

1. That I am well acquainted with the English and Korean language.
2. That the following is correct translation into English of the accompanying certified copies of the Korean Patent Application No. 10-2002-0040773.

In addition, I make the solemn declaration conscientiously believing the same to be true.

Seoul, January 23, 2006

  
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## METHOD FOR IMPROVING RELIABILITY OF REACTION APPARATUS

### BACKGROUND OF THE INVENTION

#### Field of the Invention

The present invention relates to a method for manufacturing semiconductor devices, and more particularly, to a method for improving reliability of an etching apparatus and a deposition apparatus using chlorine series etching gas.

#### Description of the Related Art

According to etching or deposition apparatuses for processing wafers by the sheet in a process of manufacturing a semiconductor device, a phenomenon frequently appears in that a reactive by-product, which is generated while performing the process, remains in a reaction tube, thereby adversely affecting the wafer to be processed at a next process.

In order to reduce the effect of the residual product, two methods have been proposed: i.e., a seasoning process in which a residual product is previously saturated in the reaction tube; and an in-situ cleaning process in which after removing the residual product from the reaction tube, a following process is carried out.

According to the seasoning process, although the apparatus is stably maintained, there is a drawback in that if a lot of residual product remains in the reaction tube, it is likely that large particles are dropped onto the surface of the wafer, thereby reducing the yield.

Meanwhile, the in-situ cleaning process has a drawback of increasing a process time, but a clean process is possible, so that it is required for a process sensitive to the yield.

In particular, in a plasma etching or depositing process using chlorine series etching gas, after the compound containing chlorine is deposited on the exposed surface of the reaction tube, the chlorine may be desorbed from the exposed surface and take part in the reaction, thereby varying etching and depositing properties and thus resulting in the instability of the process.

The conventional method generally utilizes an etching gas, such as  $\text{Cl}_2$ ,  $\text{SF}_6$  and so forth when performing the in-situ cleaning process. The in-situ cleaning process using the etching gas has a drawback of reducing a lifetime of components.

#### SUMMARY OF THE INVENTION

Accordingly, the present invention is directed to a

method for improving reliability of an etching apparatus and a deposition apparatus using chlorine series etching gas that substantially obviates one or more problems due to the limitations and disadvantages of the related art.

It is an object of the present invention to provide a method for improving reliability of an etching apparatus and a deposition apparatus, in which chlorine series residual reaction products deposited on an exposed surface of a reaction tube are effectively removed from the reaction tube by use of a hydrogen-based plasma and a nitrogen-based plasma.

To achieve this object and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described herein, there is provided a method for improving reliability of an etching apparatus and a deposition apparatus, the method comprising the steps of: preparing at least one of an etching apparatus and a deposition apparatus, each of the apparatuses using a chlorine series gas; and generating a plasma including at least one of hydrogen and nitrogen in one of the etching apparatus and the deposition apparatus to remove a residual remaining in a reaction tube of the reaction unit.

Additional advantages, objects, and features of the invention will be set forth in part in the description which

follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawing, which is included to provide a further understanding of the invention and is incorporated in and constitutes a part of this application, illustrates embodiment(s) of the invention and together with the description serves to explain the principle of the invention. In the drawing:

Fig. 1 is a graph indicating a surface resistance of a Ti film deposited by PECVD method using  $TiCl_4$  in terms of depositing times, according to an embodiment of the present invention.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference will now be made in detail to the preferred embodiment of the present invention, an example of which is illustrated in the accompanying drawing.

The method of improving reliability of an etching apparatus and a deposition apparatus according to the present invention is adapted to an etching or deposition apparatus in which etching gases containing chlorine, such as  $\text{Cl}_2$ ,  $\text{BCl}_3$  or the like and deposition gases, such as  $\text{TiCl}_4$ ,  $\text{TaCl}_5$  or the like are dissolved by use of plasma to etch a surface of a wafer or to deposit materials on the surface of the wafer.

In order to remove the compound containing chlorine remaining in a reaction tube of the apparatus after the respective etching and depositing processes, the reaction tube in stand-by after the processes is treated with hydrogen or nitrogen-based plasma.

At this time, the hydrogen-based plasma serves to remove chloride, in which plasma argon gas may be added to activate the plasma. In addition, the nitrogen-based plasma serves to replace Cl with nitrogen so as to react with Al, Si, Ti, Ta and the like contained in the chloride compound to form nitrides, which minimizes the effect exerting on the following process.

The above processes may be applied in sequence as the following.

In a first process, after the hydrogen-based plasma (containing argon, if necessary) is generated in the etching or deposition apparatus using chloride series gas, the

following etching or deposition is performed.

In a second process, after the nitrogen-based plasma (containing hydrogen and argon, if necessary) is generated in the etching or deposition apparatus using chloride series gas, the following etching or deposition is performed.

Finally, in a third process, after the hydrogen-based plasma (containing argon, if necessary) and the nitrogen-based plasma (containing hydrogen and argon, if necessary) are generated one after another in the etching or deposition apparatus using chloride series gas, the following etching or deposition is performed.

In the above processes, the hydrogen-based plasma may preferably contain 5 to 90% of argon. Also, the nitrogen-based plasma may preferably contain either 5 to 50% of hydrogen or 5 to 90% of argon, or combination thereof.

As described above, with the method of improving the reliability of the etching and deposition apparatuses according to the present invention, a chloride radical remaining in the reaction tube may be removed by treating the reaction tube with the plasma, and the residual metallic materials may be stabilized.

In addition, the present invention provides an effect of removing chloride due to activation of hydrogen in the plasma and a stabilization of the surface condition of the

semiconductor device through the formation of stable nitride using the activated nitrogen.

Further, maintaining the reliability of the etching and deposition apparatuses obtained by the present invention makes the etching or deposition features for the wafers improved in the etching or deposition apparatus in a sheet supply mode. Also, a preventive maintenance (PM) period of the apparatus may be reduced to increase an operating time of the apparatus.

Furthermore, the method of the present invention does not damage the apparatus in comparison with the conventional seasoning method or the conventional in-situ cleaning method using etching gas.

In addition, the method of the present invention is a stable one that does not discharge pollution material, because of only using hydrogen, argon, nitrogen or the like which has no fluidity.

The forgoing embodiment is merely exemplary and is not to be construed as limiting the present invention. The present teachings can be readily applied to other types of apparatuses. The description of the present invention is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art.

What is claimed is:

1. A method for improving reliability of an etching apparatus and a deposition apparatus, the method comprising the steps of:

preparing at least one of an etching apparatus and a deposition apparatus, each of the apparatuses using a chlorine series gas; and

generating a plasma including at least one of hydrogen and nitrogen in one of the etching apparatus and the deposition apparatus to remove a residual remaining in a reaction tube of the apparatus.

2. The method as claimed in claim 1, wherein the plasma including hydrogen comprises argon of 5 to 90%.

3. The method as claimed in claim 1, wherein the plasma including nitrogen comprises hydrogen of 5 to 50%.

4. The method as claimed in claim 1, wherein the plasma including nitrogen comprises argon of 5 to 90%.

5. The method as claimed in claim 1, wherein the plasma including nitrogen comprises hydrogen of 5 to 50% and

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argon of 5 to 90%.

#### Abstract of the Disclosure

Disclosed is a method for improving the reliability of an etching apparatus and a deposition apparatus. The method comprises the steps of preparing at least one of an etching apparatus and a deposition apparatus, each of the apparatuses using a chlorine series gas, and generating a plasma including at least one of hydrogen and nitrogen in one of the etching apparatus and the deposition apparatus to remove a residual remaining in a reaction unit of the apparatus, whereby a chlorine series residual absorbed on the reaction tube is effectively removed by use of hydrogen and nitrogen-based plasmas thus to stably secure the reliability of the apparatus.